

CLAIMS

1. A diffractive security element (1) with a half-tone image (2) comprising surface portions occupied with microscopically fine surface structures enclosed in a layer composite (10) which includes at least a transparent embossing layer (11), a protective lacquer layer (12) and a reflection layer (13) with the surface structures, which is embedded between the embossing layer (11) and the protective lacquer layer (12), wherein the surface of the half-tone image (2) is divided into image elements (4) which are composed of the surface portions and which are smaller than 1 mm at least in one dimension,

characterised in that

each image element (4) contains at least one of the surface portions from the group background field (5) and image element pattern (6),

the image element pattern (6) is arranged on the dark field (5),

the proportion of the surface of the image element pattern (6) to the surface of the image element (4) is determined at least by the surface brightness of the image original of the half-tone image (2) at the location of the image element (4) and having regard to the surface brightness of the adjacent image elements (4), and

the surfaces of the background fields (5) have first surface structures (18) and all surfaces of the image element patterns (6) have a second surface structure (19) different from the first surface structures (18), so that the surfaces of the background fields (5) differ from the surfaces of the image element patterns (6) only in predetermined viewing directions in the half-space over the layer composite (10) in the light-modifying action.

2. A diffractive security element (1) according to claim 1 characterised in that the form of the image element patterns (6) is similar in all image elements (4).

3. A diffractive security element (1) according to claim 1 characterised in that the surfaces of the image element patterns (6) are in

the form of letters, wherein the proportion of the surface of the image element pattern (6) in the image element (4) is determined by the thickness and/or the character height of the letters.

4. A diffractive security element (1) according to claim 1 characterised in that the surface structures (18; 19) are linear diffraction gratings with grating vectors (k), that in the image element patterns (6) the grating vectors (k) are parallel and that the grating vector (k) of the image element patterns (6) differs in azimuth (θ) from the grating vectors (k) of the first surface structures (18) in the background fields (5).

5. A diffractive security element (1) according to claim 4 characterised in that the image elements (4) which in the background fields (5) have the same azimuth (θ) of the grating vectors (k) are arranged in accordance with their azimuth (θ) of the grating vector (k) in rows (26; 28; 29) on the half-tone image (2).

6. A diffractive security element (1) according to claim 5 characterised in that on its surface the adjacent rows (26; 28; 29) which differ in the azimuth (θ) of the grating vectors (k) are arranged in cyclically repetitive manner in the sequence ABC, ABC.

7. A diffractive security element (1) according to claim 1 characterised in that the first surface structures (18) and the second surface structure (19) are meandering diffraction gratings whose spatial frequencies are selected from the range of 150 lines/mm to 2000 lines/mm, and that the meandering diffraction gratings of the background fields (5) and the image element patterns (6) differ at least in the azimuth range (θ) of the grating vectors (k).

8. A diffractive security element (1) according to claim 1 characterised in that the first surface structures (18) and the second surface structures (19) are asymmetrical diffraction gratings, wherein the

grating vectors (k) of the asymmetrical diffraction gratings of the first surface structures (18) are oriented in opposite relationship to the grating vectors (k) of the second surface structures (19).

9. A diffractive security element (1) according to claim 1 characterised in that the second surface structure (19) in the surfaces of the image element patterns (6) is a diffractive scatterer selected from the group of isotropic and anisotropic matt structures, kinoforms, diffraction gratings with circular grooves at a groove spacing of 1 to 3 μm and the matt structures superimposed with a diffraction grating.

10. A diffractive security element (1) according to claim 9 characterised in that the background fields (5) as the first surface structure (18) have a structure from the group which includes flat mirrors, cross gratings with spatial frequencies of greater than 2300 lines/mm and motheye structures.

11. A diffractive security element (1) according to claim 9 characterised in that the background fields (5) as the first surface structure (18) have a linear diffraction grating with a spatial frequency from the range of 150 lines/mm to 2000 lines/mm and grating vectors (k) which are oriented in mutually parallel relationship.

12. A diffractive security element (1) according to claim 1 characterised in that the first surface structures (18) and the second surface structure (19) are linear or meandering diffraction gratings which differ in spatial frequency (f).

13. A diffractive security element (1) according to claim 1 characterised in that pattern strips (36) of a width (B) of 15 μm to 300 μm extend at least over a part of the surface of the half-tone image (2), that in the pattern strips (36) surface strips (40) of a line width in the range of 5 μm to 50 μm form line patterns from the group which includes letters,

texts, line elements and pictograms, that the surface strips (40) of the line pattern in the surface of the pattern strip (36) partially cover the background fields (5) and the image element patterns (6) with pattern structures (37) and that the pattern structures (37) differ from the first and second surface structures (18; 19) in at least one structural parameter.

14. A diffractive security element (1) according to claim 13 characterised in that in all image elements (4) the image element patterns (6) are of the same size and that the line width of the surface strips (40) in the background fields (5) is constant while the surface brightness of the image element patterns (6) is controlled in accordance with the image original for the half-tone image (2) by means of the line width of the surface strips (40) in the pattern strips (36).

15. A diffractive security element (1) according to claim 12 or claim 13 characterised in that the spatial frequency (f) of the linear diffraction gratings in the pattern structures (37) is dependent on the location on the half-tone image (2).

16. A diffractive security element (1) according to claim 1 characterised in that the half-tone image (2) is part of a mosaic of surface portions (44) occupied by surface structures which are independent of the half-tone image (2).

17. A diffractive security element (1) according to claim 1 characterised in that the layer composite (10) is adapted to be fixed by adhesive on a substrate (17).